

CIRCUIT DESCRIPTION

1. Counter (Single-input) Flip-Flop (FFa) 1 T D 8

The type "a" flip-flop is used as a binary counter with a separate reset line. This circuit changes state for each negative step at the input. The reset line requires a momentary ground, either through a switch or through another transistor. Normally the flip-flop is reset to the "zero" state, but this may be reversed by connecting the anode of the reset diode to the other collector of the basic flip-flop. Typical output rise and fall times will be 0.5 microsecond, and a delay from the input trigger to the rise of an output may be as long as 1 microsecond.

2. Two-Input Flip-Flop (FFb) 1 T D 7

The comments made above for the single input circuit also apply to this bistable circuit, except that separate input triggers are required. When this flip-flop is triggered at one input it will stay in that state until a trigger appears at the other input, or until the reset line is grounded.

3. Amplifier (B)

This buffer circuit is an emitter follower current amplifier which may be driven by any of the other standard circuits. Output waveforms will be essentially the same as the input, except for delay caused by storage effects in the transistor.

4. Inverter (I)

The inverter circuit changes a "1" to a "0" and vice versa without changing the standard voltage levels as defined for the two conditions.

5. "AND" (A)

The and circuit will have a "1" output only when all inputs are "1"s. For any other input conditions the output will be a "0".

6. "OR" (O)

The or circuit will have a "1" output when any one of the inputs is a "1", or when any number of them are "1"s. Its output will be "0" when all inputs are "0".

7. Pulse Reshaper (P)

The pulse reshaper is a squaring circuit with an input impedance of about 70,000 ohms. The output of this circuit will be a "1" for an input level of about 3 volts, and a "0" when the input falls below about 2.5 volts. Rise and fall times at the output will be typically 0.5 microseconds.

8. Relay Driver - Type A (RA)

The relay drivers are used to supply current to one coil of a magnetic latching relay rated at 36 vdc and 1400 ohms. The type A circuit is a monostable timing circuit plus a current amplifier. When triggered by a positive-going step, the circuit supplies current to the relay coil for about 20 milliseconds.

9. Relay Driver - Type B (RB)

The type B driver is a current amplifier only and is used where the input waveform lasts longer than 4 milliseconds and can be used to drive the relay directly. This circuit must be driven by an amplifier, inverter or flip-flop.

10. One-Shot (M)

This monostable circuit is used to supply waveforms of a duration which is not readily available otherwise.

11. X, Y, and Z Circuits

These circuits are combinations of the basic circuits which have been redrawn because they occur frequently. The X circuit selects the proper half frame of the paper tape. The Y and Z circuits compare the programmer outputs with the paper tape. The output of a Y or Z is a "1" if the inputs are alike, and a "0" if they are not the same.

CONVENTIONS AND NOTATIONS

A "one" is defined as $+10 \text{ volts} \pm 1 \text{ volt}$. A "zero" is defined as $0 \text{ volts} \pm 1 \text{ volt}$. A typical one will be 10.7 to 10.8 volts, and a typical zero will be less than 0.4 volts. All inputs from the programmer are shaped to satisfy these requirements before they are operated upon.

On the paper tape, a hole is defined as a one. For the relay outputs of the programmer, a circuit closed to ground is a zero and an open circuit is a one.

All indicator lights (except push buttons) are connected to light for a one and be off for a zero.



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ALLOWABLE LOADING OF CIRCUITS

<u>Type</u>	<u>Name</u>	<u>Allowable load (gates, mixed)</u>
B	Amplifier (buffer)	5
I	Inverter	10
FFa	Flip-flop	10
FFb	Flip-flop	10
P	Pulse reshaper	5
M	One-shot	5

For "and to and" circuit a buffer amplifier is needed after each gate.

For "and to or" circuit no buffer is needed.

Connecting two "and" gates to the input of an amplifier or inverter automatically "or"s the two gate outputs.

